

Creatinine Measurement

NKDEP Manufacturer's Workshop

AACC 2004

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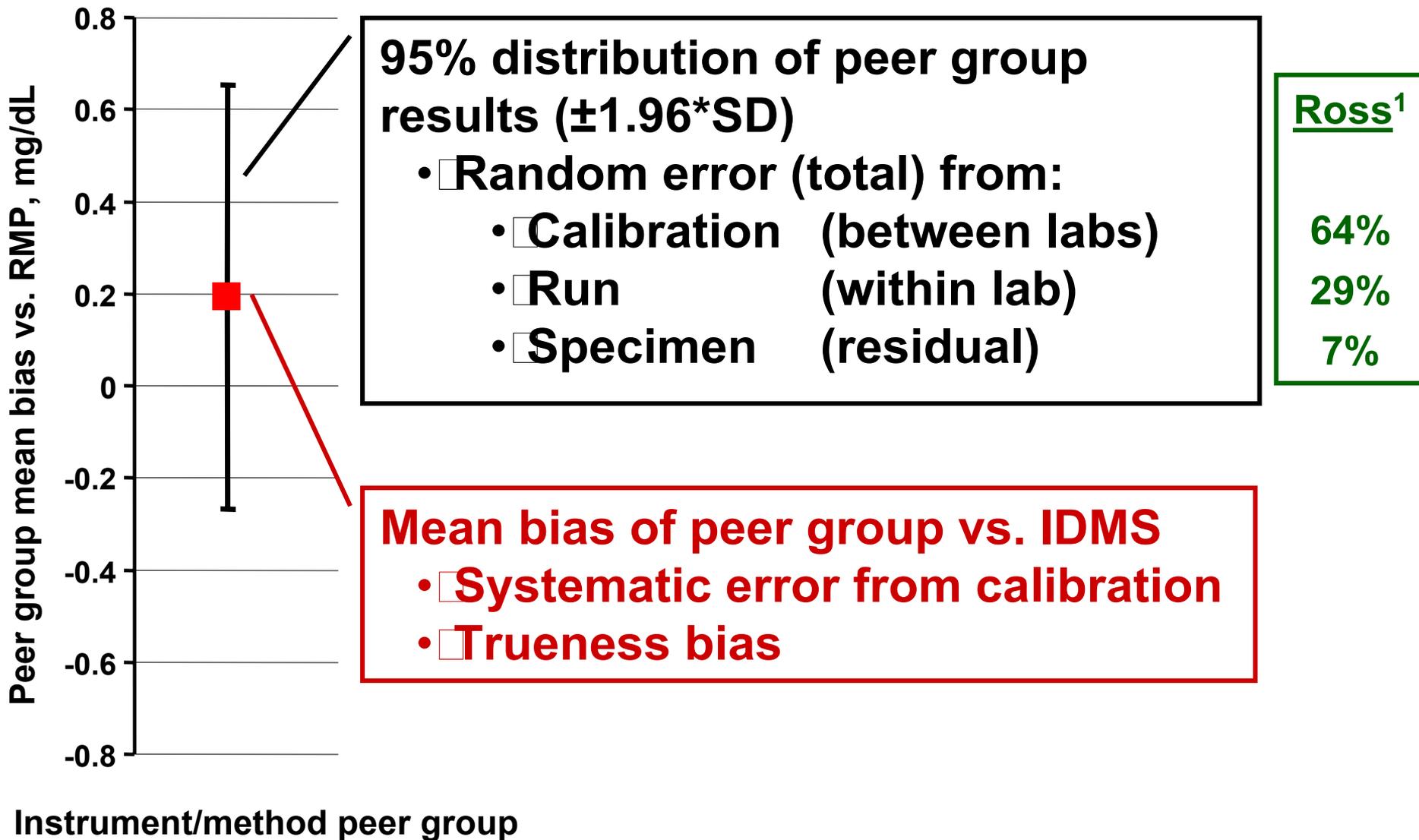
Virginia Commonwealth University

Richmond, VA

Creatinine routine method performance

- **CAP Chemistry Survey, October 2003**
 - ▶ **Fresh frozen serum specimen**
- **EU International Measurement Evaluation Programme (IMEP-17) 2002**
 - ▶ **Fresh frozen serum specimen**
- **Bio-Rad individual laboratory QC data for 2002**

CAP FFS specimen, data presentation



IMEP-17, 2002, Fresh Frozen Serum, N = 833

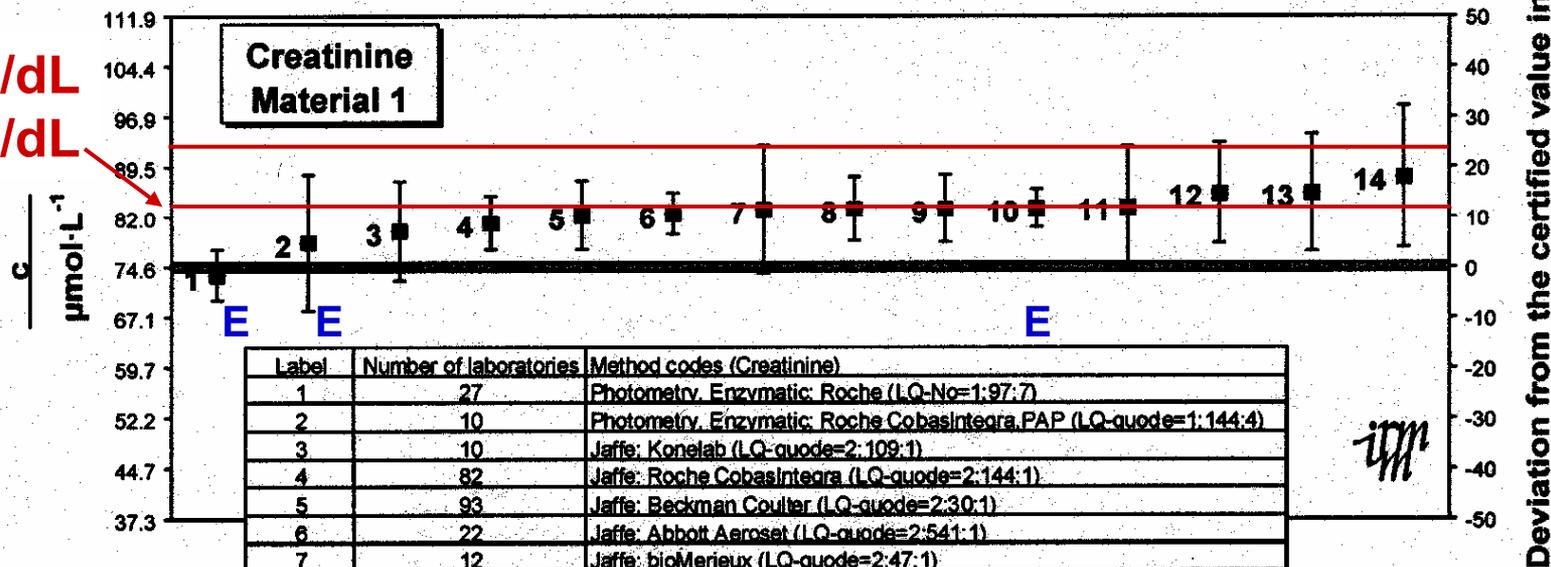
Creatinine = 0.84 mg/dL (74.6 μmol/L)

VERTICAL BARS = ±1 SD for distribution of participant results

IMEP- 17: Trace and minor constituents in human serum

Certified value : $74.57 \pm 0.57 \mu\text{mol}\cdot\text{L}^{-1}$ [$U=k\cdot u_c$ ($k=2$)]

0.2 mg/dL
0.1 mg/dL

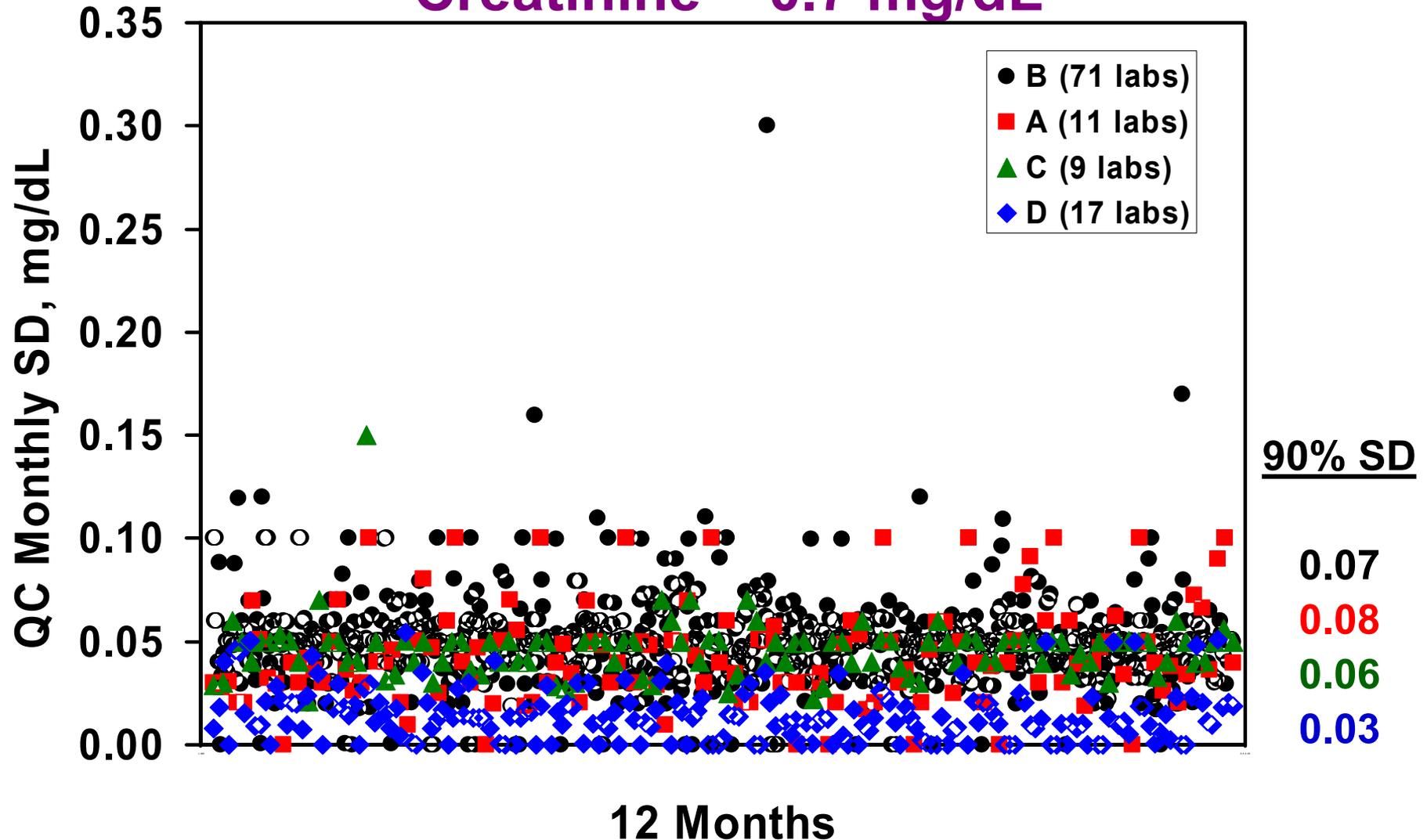


| Label | Number of laboratories | Method codes (Creatinine) |
|-------|------------------------|--|
| 1 | 27 | Photometry, Enzymatic, Roche (LQ-No=1;97;7) |
| 2 | 10 | Photometry, Enzymatic, Roche CobasIntegra.PAP (LQ-quode=1;144;4) |
| 3 | 10 | Jaffe, Konelab (LQ-quode=2;109;1) |
| 4 | 82 | Jaffe, Roche CobasIntegra (LQ-quode=2;144;1) |
| 5 | 93 | Jaffe, Beckman Coulter (LQ-quode=2;30;1) |
| 6 | 22 | Jaffe, Abbott Aeroset (LQ-quode=2;541;1) |
| 7 | 12 | Jaffe, bioMerieux (LQ-quode=2;47;1) |
| 8 | 69 | Jaffe, Olympus (LQ-quode=2;36;1) |
| 9 | 52 | Jaffe, DadeBehring Dimension (LQ-quode=2;180;1) |
| 10 | 120 | Vitros 250-950 (LQ-quode=24;5;3) |
| 11 | 33 | Jaffe, Roche.endpoint (LQ-quode=2;97;2) |
| 12 | 38 | Jaffe, Self-made reagents, kinetic (LQ-quode=2;371;1) |
| 13 | 254 | Jaffe, Roche.kinetic (LQ-quode=2;97;1) |
| 14 | 11 | Jaffe, Bayer Technicon (LQ-quode=2;49;1) |

The averages of all results (based on all replicates measured) for each method when applied by more than 10 laboratories

Bio-Rad inter-lab QC comparison (within-lab monthly SD for a single lot QC)*

Creatinine ~ 0.7 mg/dL

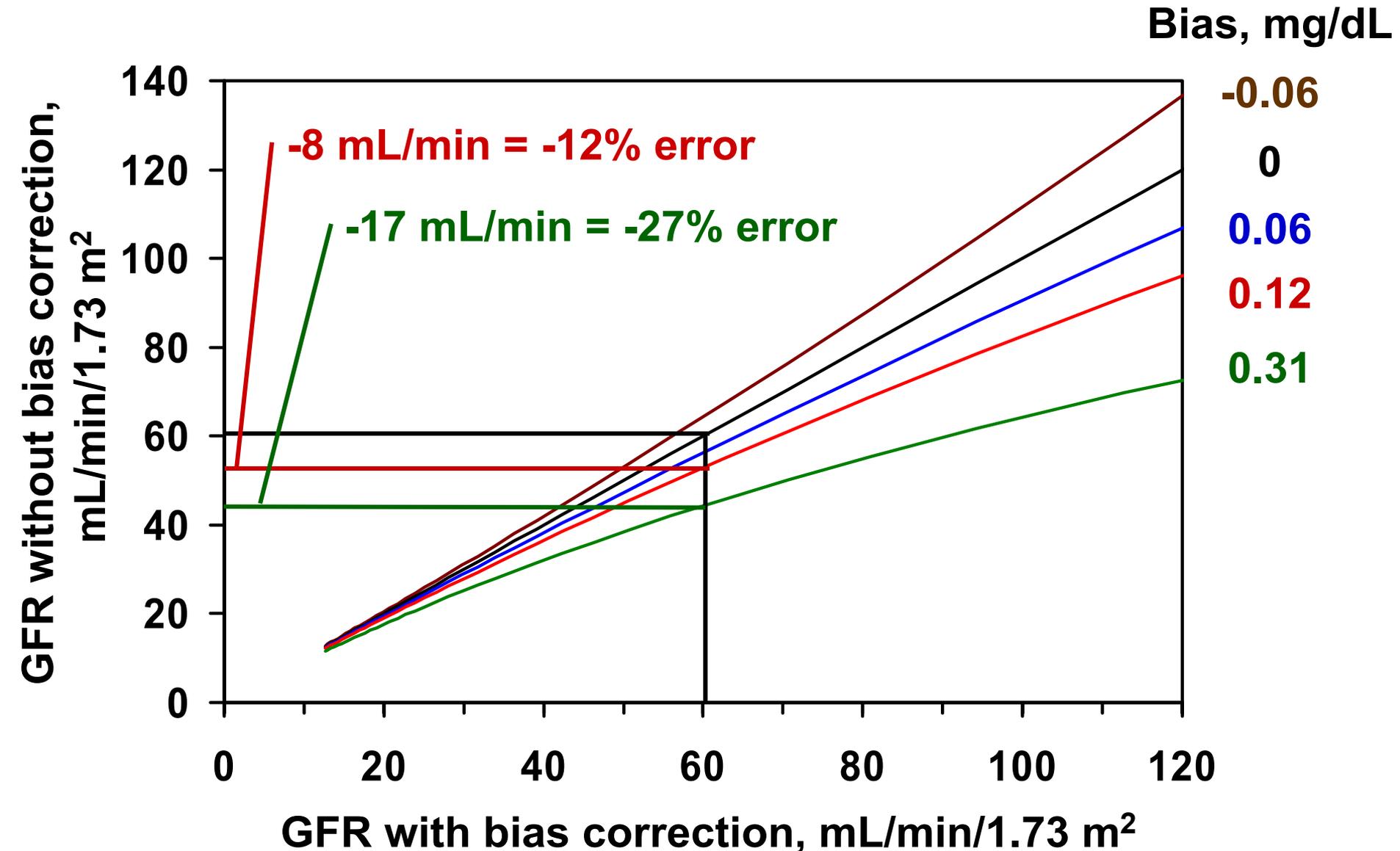


* Bio-Rad Laboratories, Inc. Liquid Multiqual, 2002

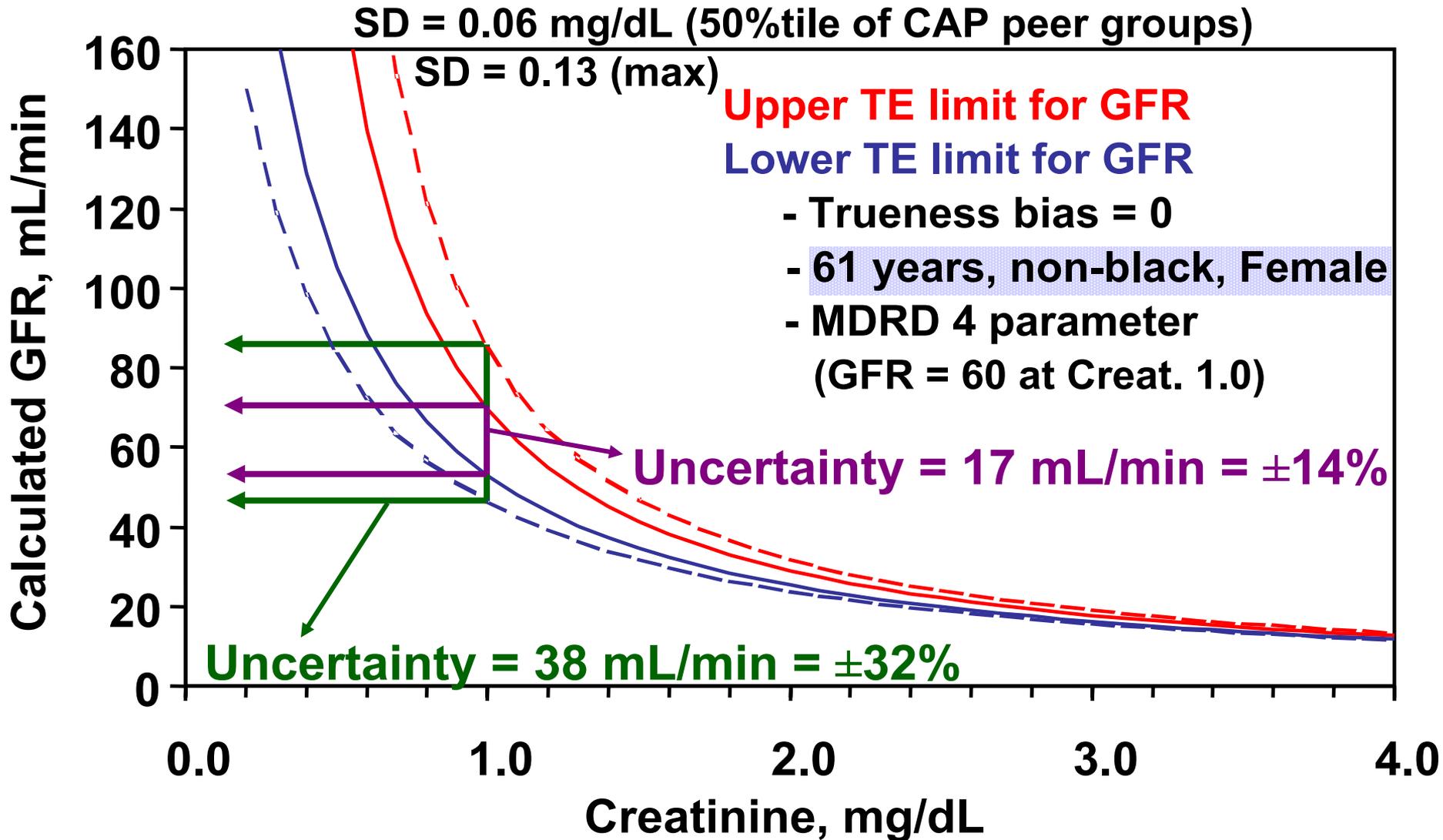
How does current performance impact calculated GFR

- **Four parameter MDRD equation**
- **Critical serum creatinine**
 - ▶ **Adults:**
 - **1.0-1.6 mg/dL (88.4-141 $\mu\text{mol/L}$)**
@ GFR = 60 mL/min/1.73m² for different demographic groups
 - ▶ **Pediatrics: lower values challenging**

Impact of creatinine bias on GFR



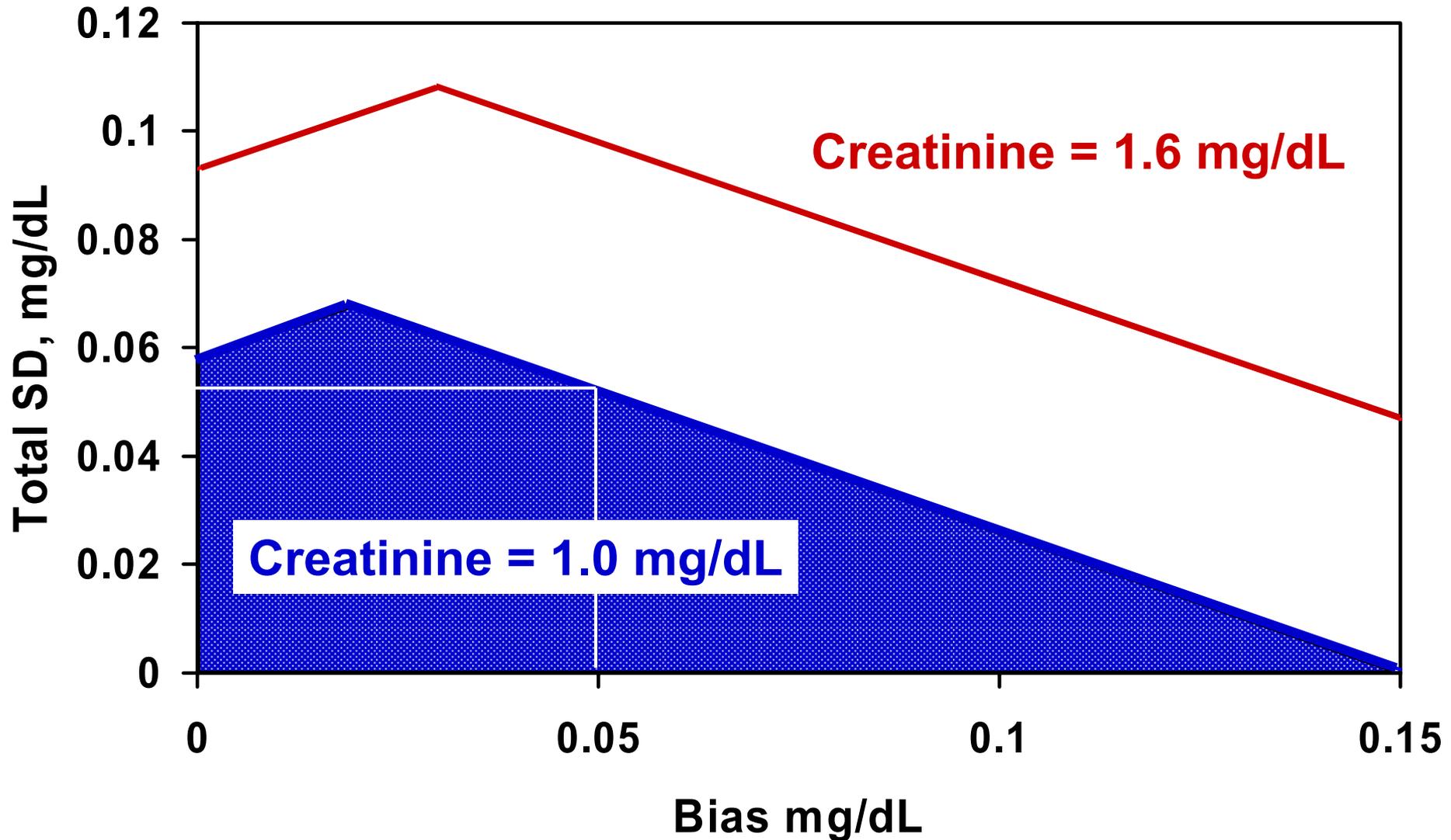
Impact of method variability on GFR



What creatinine performance is needed

- **Clinical goal = total error in GFR of $\pm 30\%$**
 - ▶ **MDRD equation coefficients contribute $\pm 15\%$**
- **Measurement contribution to GFR maximum TE $\pm 15\%$ at 60 mL/min/1.73m²**
 - ▶ **Error budget for bias vs. total SD at critical creatinine (1.0 mg/dL; 88.4 $\mu\text{mol/L}$)**
 - ▶ **PLUS method non-specificity**

Creatinine error budget for GFR total error = 15% at 60 mL/min/1.73m²



Creatinine method non-specificity

- **Alkaline Picrate**
 - ▶ Keto acids
 - ▶ Glucose and other metabolites
 - ▶ Proteins
 - ▶ Drugs
- **Enzymatic**
 - ▶ Drugs (fewer)

Summary: Creatinine Measurement (Adults)

- **Total error goal = $\pm 15\%$ in GFR_{MDRD}**
- **Current bias and variability are too large for clinical requirement**
- **Reduce bias by making calibration traceable to IDMS**
 - ▶ **Standardize MDRD coefficients for zero bias**
- **Reduce variability**
- **Non-specificity is a limitation**